

# Making informed decisions about incorporating a CAD/CAM system into dental practice

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Dental materials, technology and equipment have combined to produce computer-aided design (CAD) and computer-aided manufacturing (CAM) of dental restorations. One such system, CEREC (Sirona Dental Systems GmbH, Bensheim, Germany), has for 20 years enabled dentists to perform routine chair-side fabrication of indirect, bonded ceramic and resin-based composite restorations.<sup>1</sup> Researchers have found CEREC restorations to perform predictably not only in longevity and wear, but also in sensitivity, retention, strength and marginal fit.<sup>2-5</sup>

Because experiences vary with each practitioner as a result of individual practice styles, team members and patient expectations, CAD/CAM technology may not be right for everyone. Practitioners must consider a variety of factors when making a CAD/CAM purchase: their own knowledge of and success with bonded restorations and their preparation design, the

## ABSTRACT

**Background.** The authors drew from their clinical application and practice management experience to present a guide to incorporating into the dental practice computer-aided design/computer-aided manufacturing (CAD/CAM) technology for creating dental restorations.

**Methods.** The authors examine various factors in the purchase of CAD/CAM technology: clinical considerations and implications, practice and patient impact, and practical aspects of financial return. They also offer guidelines to and provide questions for dentists who may be considering a purchase of such technology.

**Conclusions.** CAD/CAM technology is a key component for a technologically current dental office.

**Clinical Implications.** Today's dental care consumer is more aware of his or her treatment options, and CAD/CAM technology may help the dentist meet such a patient's needs. With software improvement, attention to user-friendliness and positive clinical performance history, CAD/CAM systems are a significant stride forward into one-appointment esthetic dentistry.

**Key Words.** Computer-aided design/computer-aided manufacturing; CEREC; porcelain; indirect restorations.

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need for patient education, team members' acceptance of the system, negative laboratory experiences, their ability to accept the defined treatment protocol, their ability to accept the implementation of computer technology and the incorporation of the system into the office and the daily practice.

Material selection for CAD/CAM has improved greatly with the wide range of materials now available for CEREC technology. Practitioners can choose from feldspathic porcelain, leucite-reinforced porcelain and resin. These materials come in an assortment of shades, color gradients and translucencies, which allow for improved esthetic matching to the patient's dentition. Practitioners can achieve even greater detail and occlusal characteristics through staining application to the superficial ceramic layer that then can be glazed and fired. Manufacturers are producing all-ceramic and resin-based composite blocks that provide a dense restorative product without imperfections. The use of these porcelain and resin-based blocks provides quality control, minimizes polymerization shrinkage and limits this measurable property to the resin cement that is used.

The overall approach to CAD/CAM technology and the decisions that surround each restoration have become easier and more predictable through improved milling software, restoration design options and material selection.

In particular, the software has become much simpler and the initial learning curve has improved greatly in the last five years. CEREC's software offers the ability to design a restoration, copy an existing tooth and adjust the occlusion virtually. Most restoration designs can be accomplished in less than five minutes and then milled in 10 to 12 minutes. Recent software improvements have cut the milling time by about 30 percent. As clinicians gain confidence and become more proficient in producing single posterior restorations, they will be able to offer progressively more advanced or esthetically challenging restorations for their patients who need them. In essence, the clinician combines computer-aided technology with artistry.

## **CONSIDERATIONS IN INCORPORATING A CAD/CAM SYSTEM INTO PRACTICE**

**Advantages of CAD/CAM in a private dental office.** The concept that a dentist can, in a single appointment, administer anesthetic in prepara-

tion for, prepare the tooth for, make an impression for, design, mill, customize and place a restoration is desirable for many clinicians and patients. The command of "one-appointment" dentistry is powerful not only for the patient, but also for the entire dental team and the office's productivity.<sup>6</sup> Single-appointment dentistry has a variety of benefits: the need for only one administration of anesthetic, the absence of need for temporary or provisional restorations (therefore, no lost temporaries or re-cementations), the absence of laboratory fees and a reduction in second-chair set-up costs. These factors ultimately equate to fewer instruments needing to be sterilized, less need for chair time set-up/breakdown and improved office efficiency. Another, often-overlooked advantage is the disposable supplies that can be eliminated (from impression material, wax, stone, temporary bridge resin and cement to cotton and paper disposables) by institution of a CAD/CAM system.

Clinicians can gain other intangible advantages in the long term by introducing CAD/CAM technology into their already-busy dental practices. With CAD/CAM technology, clinicians maintain total product and artistic control of the restorations to be fabricated and seated. It allows clinicians to spend the majority of their time on tooth preparation and on seating of the final restoration; the software programs' options deliver a product that may need only endpoint characterization, staining or glazing. The computer and milling processes diminish potential inaccuracies resulting from the hand/laboratory fabrication process and are able to provide a restoration that fits within the 50-micrometer range established by the American Dental Association.<sup>7</sup>

When the dentist implements CAD/CAM technology, he or she must create a schedule that supports single-appointment treatment. In our opinion, this schedule arrangement can both save time and increase efficiency. Dentists can complete most CEREC single-unit crowns within one and one-half hours. Dentists can treat quadrants within two or two and one-half hours. With this type of dentistry, the second "seating" appointment now is freed up and can be redesignated for an additional productive appointment. Given a traditional two-appointment procedure and time allotment, this single-appointment treatment approach becomes practical. Moreover, a practitioner seasoned in using CEREC can perform additional procedures while the restoration is

being milled, again enhancing the practice's efficiency and productivity.

Patients often experience irritation in, sensitivity in and/or difficulty in cleaning temporized teeth. Single-appointment dentistry avoids these complaints. Also, clinicians must consider the diminished chance of bacterial invasion during this phase; decreased pulpal stress resulting from excessive cleaning, drying or trauma; and decreased need for the additional tooth manipulation that often is experienced at a second appointment. Given the fact that veneers represent a significant portion of laboratory-fabricated restorations today and that veneer temporaries easily can be displaced and are time-consuming to fabricate, dentists should find the convenience of single-appointment dentistry significant. Furthermore, the CEREC veneer software program is easy to use and will enhance the implementation of single-appointment dentistry.<sup>8,9</sup>

Dentists have the ability to include their team members by delegating some of the tasks in the CEREC process. In such a scenario, assistants may be included in introductory CEREC training and can better their skills by taking additional training courses specifically designed for assistants. In practice, the team approach flows thus: the dentist prepares the tooth, powders it and takes the optical impression. Then the assistant designs the restoration, mills it, polishes it and prepares it for bonding. Finally, the dentist completes the procedure by bonding the restoration.

**Disadvantages of using CAD/CAM in a private office.** In the implementation of any new technology, discussions arise that require critical thinking. The primary consideration in a CAD/CAM purchase is the length of the learning curve, which may range from a few days to several months and may result in the loss of office production, the loss of patient treatment time and an increase in the clinician's frustration. Other obstacles to incorporating this system into practice are the cost of the equipment, the potential for the dental team to resist the system's use, the clinician's lack of confidence in using a computerized system, and perhaps the clinician's lack of willingness to learn a new concept that will require training and practice. Dentists who have

difficulty integrating this technology into their practices usually are dentists who do not want to change the way they are practicing.

#### **LIMITATIONS OF AN IN-OFFICE CAD/CAM SYSTEM**

**Cost of the CEREC machine.** The CEREC milling unit and an acquisition unit cost approximately \$96,995 plus tax, equating to a monthly payment of \$2,100 per month; no lease option is offered. The CEREC Club, which provides software upgrades, updates, annual maintenance and a 50 percent discount on some parts, costs \$209 per month for an optional three-year membership agreement (Patterson Dental, e-mail communication, April 2006).

**Team training.** While a dentist can achieve an initial level of competence after a two-day training session, he or she will need more instruction to

become proficient enough to use the software fully. Most clinicians and assistants who use CEREC increase their skills by continuing to an intermediate training level and then studying with advanced trainers.

**Finished product: color matching and staining, longevity.** Matching the patient's tooth shade to the blocks of materials used to fabricate the restorations can be a challenge initially. Multicolored blocks are available either in Vita Classic Shades

(Vita Zahnfabrik, Bad Säckingen, Germany) or Vitapan Shades (Vita Zahnfabrik); however, some clinicians find it necessary to use a digital shade-matching system to help select the correct color. Staining CEREC restorations is an easy technique to learn, but it does require additional training and another expense—for a porcelain furnace or glazing oven—if the clinician desires to handle this level of characterization.

**Severely broken-down teeth: subgingival margin capture.** The CEREC system's camera relies on margin capture, thus making subgingival margin capture challenging. Generally, CEREC trainers recommend that subgingival margins be exposed with a soft-tissue diode laser. The laser adds an additional expense to the treatment armamentarium.

**Patient acceptance of and response to CEREC capabilities.** Many trends in dentistry

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are without a doubt driven by patients, materials and equipment. Patients are becoming savvy about dental health and treatment mainly because of esthetic, image-targeted marketing. Education and perception continue to generate a widespread acceptance of and desire for esthetic dentistry. Moreover, with patients' growing knowledge about the latest products, their expectations will rise, and they are capable of pushing one-appointment dentistry into the forefront for reasons of both convenience and esthetics.

CEREC enables the patient to be treated in one visit. This allows the clinician to be respectful of the patient's time, pleases a patient who appreciates convenience and promotes an office that recognizes the value of "lost time," especially in the workplace.

**Cost-effectiveness of an in-office system.** When considering a major technology purchase for a dental practice such as that of a CAD/CAM system, dentists must devote some thought to their potential return on investment. For clinicians who want to increase their knowledge of all-ceramic restorations, we believe that they must achieve clinical education, understanding of the dental materials involved and a commitment to technology before making a large purchase that "promises" financial reward.

Given that the average laboratory-fabricated crown costs about \$120, the clinician needs to mill about 17 units per month to benefit from a purchase of a CAD/CAM system.<sup>10</sup> The dentist, therefore, needs to evaluate whether such production is possible or desirable in his or her practice.

## REALITIES OF AN IN-OFFICE SYSTEM

**Upgrades of hardware and software.** In an area of ever-advancing technology such as CAD-CAM, upgrades and updates are to be expected. Anyone considering purchasing this technology should inquire about the software and how quickly it may become obsolete. It is wise to question how long the technology has been on the market and how soon a revision will become available.

**Technical support.** The dentist may need to budget for monthly expenses for technical support and software upgrades as previously mentioned according to the user agreement. The dentist

should inquire about support availability and costs as well.

When a dentist purchases a CEREC unit, a CEREC specialist from Patterson Dental (St. Paul, Minn.) spends one day on site to install the unit and to ready the dentist and team members, if appropriate, for the two-day introductory course. The installation fee also includes a \$500 travel expense offset for training, a \$2,000 education voucher redeemable toward tuition at any of the more than 30 Patterson training facilities in the United States, and the CEREC tutorial on compact disc.

**Cost of supplies.** Generally, the cost of supplies for an average CEREC restoration is about \$26. The dentist may purchase ceramic or resin milling blocks in volume, thus reducing the cost. He or she also will need diamond milling burs, reflective powder coating, optional reflective liquid coating and CEREC lubricant.<sup>9</sup>

**Learning curve.** A new user of CAD/CAM technology can gain a predictable level of competence after two days of training. The majority of

dentists achieve an acceptable comfort level after creating and placing approximately 20 to 30 restorations. Users can further their ability by taking intermediate and advanced courses.

## WHAT QUESTIONS SHOULD A CLINICIAN ASK BEFORE BUYING A CAD/CAM SYSTEM?

### Questions dentists should ask themselves.

Dentists must plan for training and integration when considering a CAD/CAM purchase. Educated consumers of dental technology must gather background information on, evaluate and question not only their commitment to the technology, but also its effects on their practices' team members and patients. Specifically, dentists should consider the following:

- willingness to commit to training (on the part of both the dentist and team members);
- their commitment to involving team members in expanded treatment and chairside dentistry;
- their motivation to adapt the practice schedule to single-appointment dentistry;
- an assessment of whether technology means better-quality dentistry for the patient;
- realism about profit and patience for achieving profit in a reasonable period.

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**Questions dentists should ask the company.** Dentists are not the only subjects of the prospective CAD/CAM buyer's scrutiny. They also must ask important questions of the CAD/CAM supplier:

- Has the company that supports this technology been in business for a long period? Are its technicians well-trained and is its software technical support easy to access?
- How long does the warranty last, what does it cover and how is the system maintained and serviced?
- Is this training available in many areas of the country for ease of travel?
- How far in advance must one schedule training before using the CAD/CAM unit?
- What materials and support will be available after purchase to provide the buyer with a jump-start on self-education?
- Can the company provide a list of references consisting of reliable dentists who are using the technology?

## CONCLUSIONS

Dentists must consider many factors when purchasing large equipment or innovative technology such as a CAD/CAM system. They should be well-

prepared regarding background information, their own motivation and the potential financial return of such a purchase. Intelligent questions generate a targeted response from the representative that benefits the patient, the team and the dentist. Regardless of whether a dentist purchases the technology, this fact-finding mission ultimately will create a more satisfied, informed consumer: the dentist. ■

1. Mörmann WH, Brandestini M, Lutz F, Barbakow F. Chairside computer-aided direct ceramic inlays. *Quintessence Int* 1989;20:329-39.
2. Wiedhahn K, Kerschbaum T, Fasbinder DF. Clinical long-term results with 617 CEREC veneers: a nine year report. *Int J Comput Dent* 2005;8:233-46.
3. Nakamura T, Dei N, Kojima T, Wakabayashi K. Marginal and internal fit of CEREC 3 CAD/CAM all-ceramic crowns. *Int J Prosthodont* 2003;16:244-8.
4. Herrguth M, Wichmann M, Reich S. The aesthetics of all-ceramic veneers and monolithic CAD/CAM crowns. *J Oral Rehabil* 2005; 32:747-52.
5. Posselt A, Kerschbaum T. Longevity of 2328 chairside CEREC inlays and onlays. *Int J Comput Dent* 2003;6:231-48.
6. Morin M. CEREC: the power of technology. *Compend Contin Educ Dent* 2001 Jun;22(6 supplement):27-9.
7. Estefan D, Dussetschleger F, Agosta C, Reich S. Scanning electron microscope evaluation of CEREC II and CEREC III inlays. *Gen Dent* 2003;51(5):450-4.
8. Puri S. Techniques used to fabricate all-ceramic restorations in the dental practice. *Compend Contin Educ Dent* 2005;26:519-25.
9. Wiedhahn K. Cerec 3D veneers with R2005: veneers a la carte. *Int J Comput Dent* 2005;8(1):59-68.
10. Christensen G. Is now the time to purchase an in-office CAD/CAM device? *JADA* 2006;137:235-8.